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# SCIENCE

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CONTENTS



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## AMERICAN BOTANY AND THE GREAT WAR

THAT botany, the traditional *scientia amabilis,* should have a place in the present world war seems almost a contradiction in terms. Yet so far are we from the days when war was the concern of professional soldiers only, that one of the earliest announced requests of the British war commission was for regiments of foresters, who are first of all botanists, for service in the forests of France.

That the activities of all professional botanists should, moreover, be profoundly influenced by the war was inevitable. Botany like other sciences is international. Before the war Germany held a prominent and unique place in the botanical world. A number of American students of botany were trained in her laboratories, and although within the last decade the emigration of American students to Germany had slackened, it was the war which effectually stopped the current.

Germany held moreover an almost complete monopoly of the publication of abstracts of botanical papers. Botanists had come to take it as a matter of course that botanical abstracts would appear in German publications, and two at least of these abstract journals had attained world-wide circulation and prestige. These abstract journals are, of course, no longer available in America, if indeed they are being published. It is natural that in this particular field, now left vacant, American botanists should begin to extend their activities and it is gratifying to note that, at their last annual meeting (January, 1918), the members of the various American botanical societies inaugurated the publication of such a journal under editorship which guarantees its success.

In incidental, and somewhat unexpected, ways the war has influenced botanical studies. The shortage of potash has stimulated the

study of kelps, and the culture of these and other marine algæ; while the increased consumption and rising price of coal has led to the reopening of at least one abandoned mine which has yielded fossil plants of great scientific interest in the past and will be closely watched by paleobotanists this summer. The recently recognized value of certain species of sphagnum moss (especially *Sphagnum papillosum* and *S. palustre*) as a substitute for absorbent cotton for use in surgical dressings has enabled the very few botanists who are familiar with this rather difficult genus to render important service to the Red Cross by exploring the sphagnum resources of the country and by advising local Red Cross chapters in their efforts to locate new sources of supply.

Undoubtedly the most striking effect of the great war on American botanists has been to direct their attention more generally than ever before to problems of plant pathology. The food situation, accompanied by the educational campaign of the Food Administration and Department of Agriculture, directed popular attention to the basic fact that humanity is, in the last analysis, directly dependent on green plants for food. Statements that we "must save wheat for our allies" lent new interest to the fact that stinking smut of wheat annually costs the United States twenty-two million bushels. Urgent advice that we must use perishable fruits and vegetables to save more concentrated foods for the armies in France called public attention sharply to the fact that fresh fruits and vegetables can not easily be shipped great distances, that they are in truth highly perishable; and finally to the tragic fact that large amounts are annually lost in transit and on the market.

With this increased popular interest went a renewed realization on the part of botanists themselves of the fundamental importance of their work and of their own responsibility in such matters. They knew that stinking smut was preventable and the means of its prevention. They realized the immediate necessity, military necessity even, that it be prevented. With state and federal agencies calling attention to the need for increased utilization of fruits and vegetables came the realization that five to ten per cent. of our eighty million dollar apple crop is destroyed by diseases the control of which is well understood and aroused the determination that they should in fact be controlled.

The case of losses which occur on the market was not so simple. The methods of control of plant diseases which cause losses of fruits and vegetables in transit have been worked out in a few instances, whereas about others very little is known. The obligation, however, was equally apparent, so far as methods of control were known they must be applied, where none were known they must be found.

With such a task before them it is not surprising that American botanists have organized as never before and as a result this summer is seeing a campaign for the control of plant diseases never approached in this country. With this there is being carried on an increased amount of research on fundamental scientific questions of significance in the control of plant disease.

This increased usefulness is being brought about by better organization of the men already engaged in the work and by much outside assistance from botanists who are not, professionally, plant pathologists. Both these changes would, indeed, have been necessary in order to keep up even the normal activities in plant pathology, for the number of workers in this line, as in all lines, has been reduced by the needs of the army and navy. The younger men and in particular the graduate students preparing for work in plant pathology have enlisted in large numbers.

The organization of American botanists for greater service in the study and control of plant diseases is under the immediate direction of the War Board of American Pathologists, a representative committee appointed by the American Phytopathological Society, at its annual meeting, January, 1918. The work which this committee has already accomplished is too varied to be detailed. Three phases of its activity will sufficiently illustrate the scope and methods of its work. These are the man power census, the extension work, and the assistance of research.

A reorganization of man power, if much was

to be accomplished, was rendered absolutely necessary by the inroads due to enlistment for military service. The first step in this direction was taken by the man power census. A brief questionnaire was sent to every botanist in America, who could be reached, and on this card each man was requested to indicate his training, degree of availability and willingness to take up emergency work in plant pathology. The replies have been most gratifying in number and tone. Teachers of botany and investigators in other fields have in considerable numbers indicated a willingness to lay aside temporarily their own investigations, investigations usually of great importance to the progress of botanical science, and take up work on the control of plant diseases.

The aim of the extension work of the committee is to make available everywhere in America information now available anywhere in America. Pathologists in various states were asked to contribute any information they might have, published or unpublished, which might be of service in other sections. Responses to this request also have been prompt and enthusiastic. Pathologists all over the country have placed in the hands of the committee for general distribution information which they have acquired in their own work and which seemed likely to be useful to other workers. They have done this frequently without waiting to insure credit to themselves by prior publication. Instead of safety first they have placed service first.

In research the effort has been to call attention to those problems which were of most pressing importance and to coordinate the work of investigators in different regions. Much has been accomplished here in so arranging work that the efforts of one investigator should supplement rather than duplicate those of his neighbor.

The results of these lines of effort can not fail to be of great service. Undoubtedly the greatest immediate gain will come from the extension work, from the distribution of information to the plant pathologists of every state in the union and the further distribution of this information through the county agents and the farm demonstrators to the actual producers. It is highly probable, however, that the greatest ultimate good to plant pathology as a science and to the nation will come from the temporary enlistment of a large number of botanists from other lines. This increase is not a gain in numbers merely but a gain in different technical training, different methods of work, new points of view. So close are the interrelations of the natural sciences that striking contributions to a science are frequently made by a newcomer in the field who has been well trained in another not too closely related field. Thus it is only natural to expect that from the present mobilization of botanists of all kinds in plant pathology will come striking and valuable contributions to that science.

Neil E. Stevens

Bureau of Plant Industry,
Washington, D. C.

## A SURVEY OF HIGH-SCHOOL CHEMISTRY IN PENNSYLVANIA

For the purpose of establishing a relationship between high-school and college chemistry, the writer sent the following information blank to the 971 high schools of Pennsylvania, following the original communication by a second request.

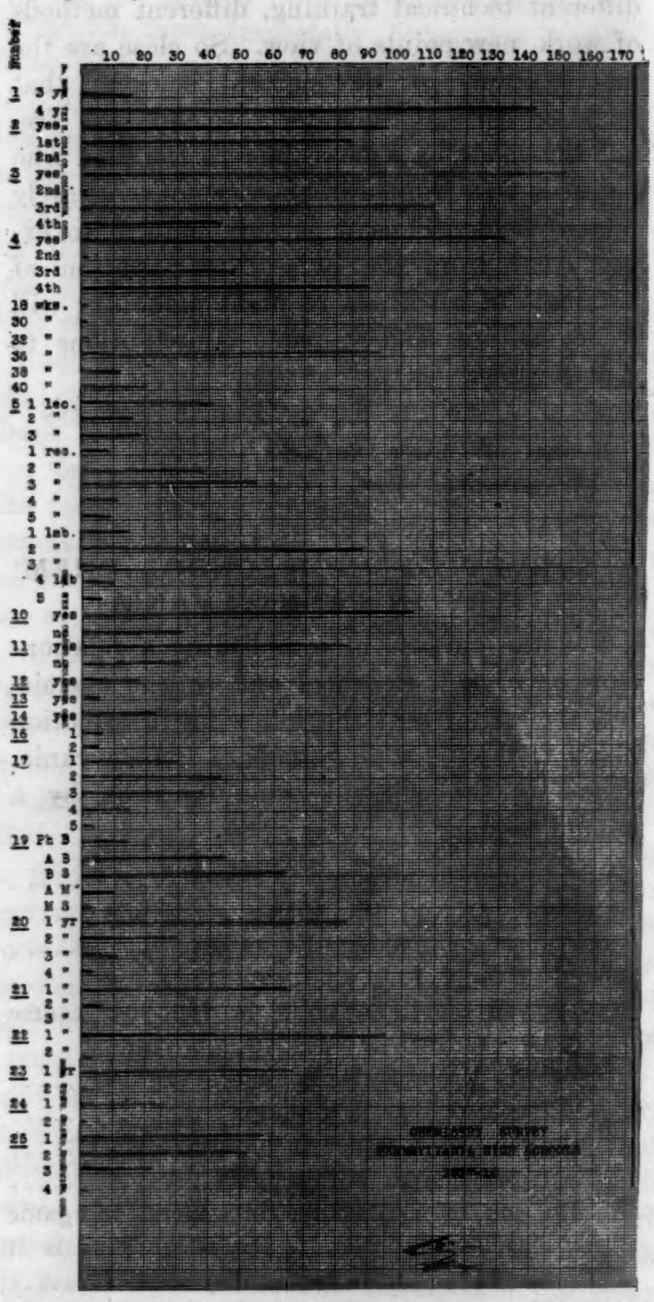
Name of high or preparatory school ............
Location .......... St., City ...... State ......
Name of officer making this report ............
Official Title ..................................

1. Do you require a three- or four-year course for graduation: .......... year.
2. Do you give a course in general science?......
   In which year is it taught? ..............
3. Do you give a course in physics?............
   In which year is it taught? ..............

*4. Do you offer a course in general inorganic chemistry? ........ In which year is it taught? ...... How many weeks? ......
   How many pupils take the course? .......
5. How many lecture periods per week? ........
   Length of period? ........
   How many recitation periods per week?....
   Length of period? ........
   How many laboratory periods per week?....

* If you offer more than one couse, furnish statistics for the one considered your college preparatory course and mention the other under 14.

Length of period? ........
How many pupils in a recitation section? ....... In a laboratory section? .......
How many recitation sections? ..........
How many laboratory sections? ..........
How many pupils per instructor in laboratory sections? ..........




6. Text book employed? ......................
7. Laboratory manual employed? ............
   Do you omit any of the experiments?......
   Which ones? ..........................
8. Chemical elements studied in course? (Cross out those not studied.) O, H, N, Cl, C, S, F, Br, I, P, B, As, Si, Sb, Bi, Na, K, Ba, Sr, Ca, Cu, Ag, Au, Mg, Zn, Cd, Hg, Al, Sn, Pb, Cr, Mn, Fe, Co, Ni, Ra.
   Do you include any not listed above? ......
9. Which of the following do you include? (Cross out any not included.) Dalton's atomic theory, law of constant proportions, combining weights, valence, Boyle's law, kinetic molecular hypothesis, Avogardo's law, Gay-Lussac's law, catalytic agent, allotropism, osmotic pressure, freezing and boiling point effects, gram molecular volume law, DuLong and Petit's law, periodic arrangement of elements, Mosely numbers, electron theory, structure of atom, ionization, Faraday's law, equilibrium, thermal equation, colloids.
   Mention laws or theories taught and not included in above list ...........................
10. Do you think that it is an advantage to have physics precede chemistry? ..................
11. Do you consider it wise to postpone chemistry to the fourth year, giving physics in the third, and mathematics during all four?.. ..........................
12. Do you offer a course in qualitative analysis? ........ Nature and scope of work? ...... ........................................ ........................................ ...... Text book? .................
13. Do you offer a course in organic chemistry? .......... Nature and scope of work? ..............................
   Text book? ............................ ........................................
14. Do you offer any other courses in chemistry? .......... Nature and scope? ....... ........................................ ........................................ ......Text book? ................. ........................................
15. (*a*) How many hours do you lecture personally per week? ........................
    (*b*) How many hours of recitation do you conduct personally per week?........
    (*c*) How many hours of laboratory work do you give personally per week? .....
16. If you have assistants how many and in which part of the work? ....................
17. Do you teach any subjects other than chemistry? If so mention the subjects and number of hours per week? ............ ........................................ ........................................
18. Colleges or universities which you have attended .................................. ........................................

19. Degrees and when obtained? ........................

.......................................................

20. Did you study inorganic chemistry in college? ........ How many years? ...........

21. Did you study quantitative analysis? ........ How many years? ........................

22. Did you study qualitative analysis? ......... How many years? ........................

23. Did you study organic chemistry? ............ How many years? ........................

24. Did you study physical chemistry? ........... How many years? ........................

25. Did you study physics? ...................... How many years? ........................

TABLE I

*Number of Pupils taking College Preparatory Course in General Chemistry*

| Number of Pupils | Number of Schools | Number of Pupils | Number of Schools | Number of Pupils | Number of Schools |
|---|---|---|---|---|---|
| 3 | 1 | 20 | 7 | 41 | 1 |
| 4 | 1 | 21 | 6 | 45 | 4 |
| 6 | 4 | 22 | 4 | 47 | 1 |
| 7 | 3 | 23 | 2 | 49 | 1 |
| 8 | 2 | 24 | 1 | 50 | 3 |
| 9 | 2 | 25 | 4 | 52 | 1 |
| 10 | 3 | 26 | 2 | 56 | 1 |
| 11 | 4 | 28 | 3 | 60 | 3 |
| 12 | 9 | 30 | 5 | 62 | 1 |
| 13 | 2 | 31 | 1 | 65 | 1 |
| 14 | 6 | 33 | 1 | 70 | 1 |
| 15 | 5 | 35 | 3 | 75 | 3 |
| 16 | 8 | 36 | 1 | 76 | 1 |
| 17 | 1 | 37 | 1 | 150 | 2 |
| 18 | 2 | 38 | 2 | 160 | 1 |
| 19 | 1 | 40 | 1 | 175 | 1 |

TABLE II

*Number of Pupils Per Recitation Section*

| Number of Pupils | Number of Schools | Number of Pupils | Number of Schools | Number of Pupils | Number of Schools |
|---|---|---|---|---|---|
| 3 | 1 | 13 | 3 | 23 | 3 |
| 4 | 2 | 14 | 8 | 24 | 3 |
| 6 | 4 | 15 | 5 | 25 | 12 |
| 7 | 4 | 16 | 12 | 26 | 2 |
| 8 | 3 | 17 | 4 | 28 | 1 |
| 9 | 4 | 18 | 8 | 30 | 6 |
| 10 | 4 | 19 | 4 | 33 | 1 |
| 11 | 4 | 20 | 15 | 35 | 2 |
| 12 | 5 | 21 | 6 | 36 | 1 |
| | | 22 | 3 | 104 | 1 |

Answers to questions 1, 2, 3, 4, 5, 10, 11, 12, 13, 14, 16, 17, 19, 20, 21, 22, 23, 24 and 25 received from 150 of the 172 high schools from which replies came are answered graphically, wholly or in part, on the accompanying chart. The remaining 22 schools do not teach chemistry.

In reply to the last question under No. 4 data shown in Table I. were obtained.

TABLE III

*Number of Pupils Per Laboratory Section*

| Number of Pupils | Number of Schools | Number of Pupils | Number of Schools | Number of Pupils | Number of Schools |
|---|---|---|---|---|---|
| 2 | 1 | 12 | 9 | 21 | 5 |
| 3 | 1 | 13 | 3 | 22 | 4 |
| 4 | 2 | 14 | 6 | 23 | 2 |
| 6 | 5 | 15 | 6 | 24 | 3 |
| 7 | 6 | 16 | 10 | 25 | 10 |
| 8 | 8 | 17 | 4 | 26 | 2 |
| 9 | 5 | 18 | 7 | 30 | 12 |
| 10 | 7 | 19 | 2 | 33 | 1 |
| 11 | 4 | 20 | 11 | 35 | 1 |

Answers to 5 (*d*) are given in Tables II. and III.

Answering question 6 the following information was given regarding text-books in use.

Avery—2
Blanchard & Wade—11
Bradbury—1
Brownlee and others—52
Cook—1
Fuller—19
Green & Keller—1
Godfrey—1
Gunnison—1
Hessler & Smith—1
Hitchcock—1
Morgan & Lyman—4
McPherson & Henderson—31
Newell—22
Remsen—2
Smith—1
Weed—2
Williams—1

Answering question 7 the following information was given concerning laboratory manuals.

| | |
|---|---|
| A. H. S. Manual—1 | McFarland—1 |
| Brownlee—31 | McPherson & Henderson—24 |
| Dennis & Clark—4 | Newell—18 |
| Cook—1 | Remsen—1 |
| Fuller—9 | Smith—1 |
| Godfrey—2 | Weed—2 |
| Knott—3 | White—1 |
| Morgan & Lyman—5 | Whitman—6 |
| | Williams—5 |

From answers to question 8 it was ascertained that the following elements, of those listed, are omitted from courses given in the number of schools indicated.

| | | | |
|---|---|---|---|
| Antimony | 17 | Gold | 16 |
| Arsenic | 13 | Iodine | 3 |
| Barium | 10 | Manganese | 7 |
| Bismuth | 22 | Nickel | 12 |
| Boron | 18 | Phosphorus | 2 |
| Bromine | 4 | Radium | 49 |
| Cadmium | 32 | Silicon | 11 |
| Chromium | 16 | Strontium | 27 |
| Cobalt | 13 | Tin | 5 |
| Fluorine | 10 | | |

In answer to question 9 it was found that the following theories, laws and principles are omitted by the number of schools indicated.

Law of constant proportions—3, combining weights—2, Boyle's law—2, kinetic molecular hypothesis—26, Avogadro's law—3, Gay-Lussac's law—5, catalytic agent—3, allotropism—16, osmotic pressure—21, freezing and boiling point effects—7, gram molecular volume law—21, DuLong and Petit's law—51, periodic arrangement of elements—15, Moseley numbers—99, electron theory—19, structure of atom—27, ionization—2, Faraday's law—25, equilibrium—8, thermal equation—45, colloids—45.

Question 15 is answered in Tables IV., *A*, *B* and *C*.

TABLE IV

(*a*) *Number of Lectures per Week per Instructor*

| Number of Lectures | Number of Schools | Number of Lectures | Number of Schools | Number of Lectures | Number of Schools |
|---|---|---|---|---|---|
| 1 | 25 | 4 | 3 | 6 | 2 |
| 2 | 9 | 5 | 2 | 7 | 2 |
| 3 | 7 | | | 8 | 2 |

(*b*) *Number of Recitations per Week per Instructor*

| Number of Recitations | Number of Schools | Number of Recitations | Number of Schools | Number of Recitations | Number of Schools |
|---|---|---|---|---|---|
| 1 | 17 | 7 | 2 | 16 | 1 |
| 2 | 24 | 8 | 6 | 18 | 1 |
| 3 | 24 | 9 | 2 | 20 | 1 |
| 4 | 16 | 12 | 6 | 21 | 1 |
| 5 | 6 | 14 | 3 | 25 | 1 |
| 6 | 3 | 15 | 3 | 26 | 1 |

With reference to question 18 it is gratifying to note that most of the science teachers in high schools are graduates of reputable colleges and universities. The writer has a list showing the number from each institution. This list is available for any one who may be interested. It would seem unnecessary to include the institutions here, because of the large amount of space required for the purpose. Seventy-four institutions are included in the list already compiled.

(*c*) *Number of Hours of Laboratory per Week per Instructor*

| Number of Lab. Hours | Number of Schools | Number of Lab. Hours | Number of Schools | Number of Lab. Hours | Number of Schools |
|---|---|---|---|---|---|
| 1 | 11 | 6 | 6 | 12 | 5 |
| 2 | 22 | 7 | 1 | 14 | 1 |
| 3 | 21 | 8 | 7 | 15 | 3 |
| 4 | 11 | 10 | 6 | 16 | 3 |
| 5 | 7 | | | 17 | 1 |

It is evident from the variety of answers already received that standardization is necessary. For this purpose the state should have a permanent committee, as long as the United States Commissioner of Education is not empowered to establish standards and enforce them. The latter procedure is naturally more desirable, as it would enable all colleges and universities to plan their courses as continuation courses instead of repeating much of the material which students in some high schools have already covered.

The writer wishes to acknowledge valuable assistance rendered by Miss Marcella Schwer.

ALEXANDER SILVERMAN
SCHOOL OF CHEMISTRY,
UNIVERSITY OF PITTSBURGH

## TWENTY-FIVE IMPORTANT TOPICS IN THE HISTORY OF SECONDARY MATHEMATICS

THE rapid increase in the number of the historical notes in our recent text-books on elementary and secondary mathematics raises the question, What should be the dominating motive in the selection of such notes? The history of mathematics is so enormous that it is clearly impossible to present a considerable part of it in such notes, but it would be possible to select for them some of the central elements of this history, which might become

nucleuses for the student's further development along this line.

To emphasize the fact that some of the present historical notes are useless from this standpoint we may mention that many of our elementary geometries state that according to tradition Pythagoras was so jubilant over his discovery of the Pythagorean theorem that he sacrificed 100 oxen to the gods on the occasion. It is difficult to see why authors of text-books waste space on such a statement. It is probably not true that such a sacrifice was made by Pythagoras, and if it were true, it could only lessen our respect for him. Just imagine meeting now a man in the act of sacrificing 100 oxen because he had made a mathematical discovery. Would you not conclude that he ought to be in an asylum for the insane?

By the time the average student reaches college he may easily have read twenty-five historical notes in his various mathematical text-books. It is therefore of interest to list twenty-five topics which have been epoch making in the development of pure mathematics and are nucleuses of an extensive history. It can scarcely be expected that all would agree entirely on what twenty-five points should be regarded as most important in the history of secondary mathematics but one may perhaps assume general agreement as regards the fact that each of the subjects of the following list is worthy of consideration in connection with this question. The order of these subjects is supposed to be chronological with respect to the beginnings of their history. (1) Numeration and notation; (2) Value of $\pi$; (3) Irrational quantities and irrational numbers; (4) Science of elementary geometry; (5) Science of elementary algebra; (6) Translations of treatises into a different language; (7) Science of trigonometry, or arithmetical geometry; (8) Algebraic solution of the general cubic and of the general biquadratic equation; (9) Use of logarithms for numerical calculations; (10) Science of analytic geometry, or algebraic geometry; (11) Science of differential and integral calculus; (12) Scientific societies supporting publications; (13) Special mathematical periodicals; (14) Ecole polytechnique; (15) Science of arithmetic, or the theory of numbers; (16) Reality of complex numbers; (17) founding of descriptive and projective geometry; (18) Theory of functions; (19) Non-euclidean geometry; (20) Theory of groups; (21) Johns Hopkins University; (22) Theory of aggregates; (23) International mathematical congresses; (24) Large modern mathematical encyclopedias; (25) International commission on the teaching of mathematics.

The above list of twenty-five important topics in the history of secondary mathematics does not include any of the subjects of applied mathematics, which have furnished strong motives for the development of pure mathematics. From the earliest times astronomy and surveying have furnished such motives especially for the development of spherical and plane trigonometry respectively. Among the subjects which furnished strong motives for some of the later developments in pure mathematics we may mention celestial mechanics, hydromechanics, and the theory of heat.

Some may be surprised to find in the above list of important topics the names of two institutions, but a little reflection will tend to make it clear that these institutions have been the centers of unusually strong mathematical influences. The early courses offered at these institutions are of great historical interest. It is true that the influence of the latter might be regarded to have been national rather than international, but the national activity which it fostered has been sufficiently extensive to merit general recognition.

It is, however, not our purpose to justify the particular selection of topics noted above. If this list will tend to direct the attention of teachers and authors to the really serious and fundamental questions of mathematical history, the purpose of its compilation will be fulfilled. Just as the material of the body of a text-book is selected with a view to furnishing matter of permanent usefulness rather than to arouse ephemeral interest, so it seems that the material for the historical notes

should be selected primarily with a view to furnishing enjoyment by growth of knowledge about the history of our subject.

The topics of this list may also be suitable subjects for consideration at meetings of mathematical clubs. In fact, it is especially important that the subjects selected for such metings should be fertile, since those who take active part in them include to a large extent the mathematicians of the future, and these mathematicians can not afford to be as ignorant of the history of their subject as are those of the passing generation.

G. A. Miller
University of Illinois

## SCIENTIFIC EVENTS

### THE CLEVELAND MEETING OF THE AMERICAN CHEMICAL SOCIETY

The annual September meeting of the American Chemical Society will be held at the Hotel Statler, Cleveland, Ohio, September 10 to 13, 1918, inclusive. There is every prospect of a large and successful meeting. The chemists of the country are showing a very decided desire to get together in these war times for conference at a time when it is so difficult to keep in touch with the progress of chemistry through our literature. A meeting of this kind offers special inducements to members of our society to keep themselves abreast of the time. Wonderful chemical advancement has taken place in America during the last year. Many chemists, both from the government service and from the industries, will be present.

Registration will begin at 3 P.M., September 9, at the Statler Hotel. Information regarding other hotels may be obtained from the chairman of the committee on hotels.

The general preliminary program is as follows:

*Monday, September 9*

4 P.M.—Council meeting at the University Club, Euclid Avenue and East 38th Street. Dinner there for the Council as guests of the Cleveland Section.

*Tuesday, September 10*

10 A.M.—General meeting. "The American Chemist's Place in Warfare," by Charles L. Parsons, Chairman of the Committee on War Service for Chemists.

Other general papers to be announced.

2 P.M.—General Symposium on the Chemistry of Dyestuffs. R. Norris Shreve, Chairman. Numerous interesting papers and addresses are being prepared. These will take up the whole of the afternoon of Tuesday and may continue on Wednesday morning in the Industrial Division.

*Evening.*—Banquet, Hotel Statler, followed by a smoker at the same place.

*Wednesday, September 11*

*Morning.*—Divisional meetings—Hotel Statler.

*Afternoon.*—Choice of excursions.

(*a*) Sanitary trip, including sewage disposal experiments, water filtration, garbage disposal.

(*b*) Steel industries, blast furnaces, by-product coke, steel—bessemer and open hearth.

(*c*) Industrial tour of Cleveland, including manufacturing centers.

(*d*) Trip to Oberlin.

*Evening.*—President's address, followed by informal reception.

*Thursday, September 12*

Divisional meetings all day.

*Late Afternoon.*—Outing to one of the country clubs, followed by reception at the Cleveland Museum of Art.

*Friday, September 13*

Choice of excursions.

(*a*) By special cars to Akron—Goodrich Rubber Co. (limited to 200), Knight Chemical Stoneware plant, and possibly pottery works.

(*b*) Auto trip to Wadsworth, near Akron—Ohio Match Co., Ohio Salt Works, and Ohio Brass Co. (limited to 50).

The usual meetings, including the annual election of officers, will be held by all the Divisions, and by the Rubber Chemistry Section, with the following special program:

The Division of Biological Chemistry is planning a symposium on plant chemistry.

The Division of Industrial Chemists and Chemical Engineers, besides continuing the symposium on the chemistry of dyestuffs, is planning a symposium on potash and a continuation of the very successful symposium on metallurgical subjects started at the Boston meeting.

The committee headed by Miss Josephine Grasselli will arrange a program for the pleasure of the visiting ladies. Details will be found in the final program.

All titles for papers should be in the secretary's hands on or before August 24 or in the hands of the secretaries of divisions on or before August 23, with the exception that titles of papers should reach the secretary of the Division of Industrial Chemists and Chemical Engineers on or before August 18. The Division of Industrial Chemists and Chemical Engineers have voted that the titles of all papers shall be sent to the secretary of the division, which title should be accompanied by an abstract; that any tile sent without an abstract shall not be printed in the program, and that the time limit for the presentation shall be five minutes, unless special arrangements are made with the secretary of the division. *By vote of the council no papers may be presented at the meeting titles for which are not printed on the final program.* "By Title" should be placed on the announcement of any paper where the author is to be absent, so that members may understand in advance that the paper will not be read.

The following are the addresses of the divisional secretaries:

Agricultural and Food Chemistry: Fred F. Flanders, 88 Corey Road, Brookline, Mass.

Biological Chemistry: I. K. Phelps, Bureau of Chemistry, Washington, D. C.

Fertilizer Chemistry: F. B. Carpenter, Virginia-Carolina Chemical Co., Richmond, Va.

Industrial Chemists and Chemical Engineers: S. H. Salisbury, Jr., Northampton, Pa.

Organic Chemistry: H. L. Fisher, Columbia University, New York City.

Pharmaceutical Chemistry: George D. Beal, Chemistry Building, University of Illinois, Urbana, Ill.

Physical and Inorganic Chemistry: W. E. Henderson, Ohio State University, Columbus, Ohio.

Water, Sewage and Sanitation: W. W. Skinner, Bureau of Chemistry, Washington, D. C.

Rubber Section: J. B. Tuttle, Secretary, Firestone Tire & Rubber Co., Akron, Ohio.

In order that the meeting may receive due and correct notice in the public press, every member presenting a paper is requested to send an abstract to Professor Allen Rogers, Pratt Institute, Brooklyn, N. Y., chairman of the society's press and publicity committee. The amount of publicity given to the meeting and to the individual papers will entirely depend upon the degree to which members cooperate in observing this request. A copy of the abstract should be retained by the member and handed to the secretary of the special division before which the paper is to be presented in Cleveland. Short abstracts will be printed in SCIENCE. The final program will be sent to all members signifying their intention of attending the meeting, to the secretaries of sections, to the council, and to all members making special request therefor by postal card or attached slip to the secretary's office.

CHARLES L. PARSONS,
*Secretary*

### THE JAPANESE BEETLE IN NEW JERSEY

A PUBLIC hearing on the proposed quarantine of a portion of New Jersey on account of the Japanese beetle, a serious pest of certain vegetables and fruit, was held by the United States Department of Agriculture in Washington, D. C., on August 20. As a result of infestation of the Japanese beetle in parts of Burlington county, New Jersey, the proposed quarantine is intended to prohibit the shipment from this territory of green sugar corn, ripe tomatoes and ripe peaches which might cause this pest to spread. A campaign of eradication authorized by Congress is now in progress, and the proposed quarantine is deemed necessary to support the measures that are being taken for the suppression of this dangerous pest.

The insect was introduced in the vicinity of Riverton, N. J., probably during the last five or six years, and presumably from Japan, in soil around the roots of iris. The beetle has thoroughly established itself, and from some 600 acres infested when the insect was first discovered it has spread and at present occurs over 7,000 to 10,000 acres, with one or two outlying points of infestation, involving approximately 25,000 acres. It is reported to be one of the most injurious insects of Japan, and its behavior in this country indicates exceptional possibilities for damage.

The insect is a general feeder, attacking the grape, peach, plum, apple and cherry, as well as many ornamental plants. It has been found injuring the sweet potato and other truck crops, especially sweet corn. The beetles penetrate the tips of the ears of sweet corn much like the common corn ear-worm and could thus be widely distributed with the shipment of the corn to the various markets. The insect feeds freely on a variety of weeds, especially smartweeds. As far as known it does not occur in other parts of the United States than in the area indicated.

### THE REHABILITATION OF WOUNDED SOLDIERS[1]

DETAILED reports compiled at five general hospitals indicate the progress being made by the Reconstruction Division of the Medical Department of the Army. Of the 537 cases sent to these hospitals from overseas and base hospitals in this country, 151 are now able to return to full duty and 212 are able to return to partial duty. Only 39 of these soldiers will be unable to follow their old occupations. A total of 122 will be able to return to their old employment and do efficient work, despite their injuries.

From the time these men landed in the United States an effort has been made to keep their minds and hands occupied. Curative education has been practised with satisfactory results. The men have shown interest in the "ward occupations," which consist of wood carving, knitting, weaving, block printing, bead-work, knotted work, embroidery, educational work and typewriting. Where facilities have been provided to give the men academic studies a genuine interest has been shown to improve their mental condition so as better to prepare them to make progress in civil occupations.

After the men reached the point where they could leave the wards they were instructed in shops and schools. Quartermaster repair shops are located near some of the hospitals and these are used to give instruction to the men in mechanical occupations. At the present time 132 soldiers are taking courses in auto mechanics and repair work.

Shorthand and typewriting have attracted the attention of 151. Other popular trades and the number of patients receiving instruction in them are as follows:

Drafting, 53; business, 49; agriculture, gardening and other work of similar nature, 235; telegraphy, 31; carpentry and bench work, 32; telephone, 47; furniture repairing, 18; painting, 11; electrical, 5.

A few men are taking courses in each of the following subjects:

Blacksmith, concrete working, bricklaying, plumbing, commercial law, printing, shoe repairing, woodworking, sign painting, cabinetwork, cartooning, drawing, ring making, bookbinding and willow work.

The disabilities of these men and the number suffering from each is given below. In some cases men are being treated for more than one ailment, hence the difference between the number of patients, 537, and the number of disabilities, 1,034.

Medical diseases: Cardio-vascular, 172; pulmonary tuberculosis, 83; functional neurosis (shell shock, etc.), 31; insanity, 11; nephritis, 25; gastro-intestinal, 17; gassed, 7; other general medical, 166; convalescent, 96; lung conditions (empyema), 23.

Surgical conditions: Orthopedic, 155; amputation, 42; eye, ear, nose, throat, 6; wound or injury, nervous system, 14; severe injury, face and jaw, 1; venereal diseases or sequelæ, 5; surgical condition genito-urinary system—

[1] Publication of statement from the office of the Surgeon-General, authorized by the War Department.

venereal, 9; non-venereal, 1; other surgical conditions, 59; convalescent, 111.

Total, 1,034.

The five hospitals reporting are: The Walter Reed, of Washington, D. C.; general No. 2, at Fort McHenry, Md.; general No. 6, at Fort McPherson, Ga.; general No. 9, at Lakewood, N. J.; and general No. 17, at Markleton, Pa.

### THE VOLUNTEER MEDICAL SERVICE CORPS

Under a plan announced on August 13 by Dr. Franklin Martin, chairman of the General Medical Board, Council of National Defense, the medical men and women of the country are to be mobilized by the Volunteer Medical Service Corps. This organization is authorized by the Council of National Defense and approved by President Wilson.

The plan provides for the enrollment of every qualified physician, man or woman, without reference to age or physical disability, not now in the service of the government.

In a letter to Dr. Martin, approving the reorganization of the corps, President Wilson says:

In cooperation with the General Medical Board of the Council of National Defense, the strong governing board of the reorganized corps will be able to be of increasing service. Through it the finely trained medical profession of the United States is not only made ready for service in connection with the activities already mentioned, but the important work of the Provost-Marshal General's office and the Red Cross will be aided and the problems of the health and of the civilian communities of the United States assured consideration.

I am very happy to give my approval to the plans which you have submitted, both because of the usefulness of the Volunteer Medical Corps and also because it gives me an opportunity to express to you and through you to the medical profession my deep appreciation of the splendid service which the whole profession has rendered to the nation with great enthusiasm from the beginning of the present emergency.

The health of the army and the navy, the health of the country at large, is due to the cooperation which the public authorities have had from the medical profession; the spirit of sacrifice and service has been everywhere present and the record of the mobilization of the many forces of this great republic will contain no case of readier response or better service than that which the physicians have rendered.

Members of the corps will be divided into three classes:

Fit to fight, men under forty.

Reserves, under fifty-five.

Home forces, over fifty-five.

Reserves will consist of those who may be called upon for the army, navy, public health service and civilian service when necessity requires. The home forces are those who are able to do civilian service only.

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## SCIENTIFIC NOTES AND NEWS

The American Central Medical Department Laboratory has been inaugurated in a French university town. Lieutenant Colonel George B. Foster, Jr., is the director. Among the scientific men who have been working at the laboratory are Major William J. Esler, professor of bacteriology at Cornell University; Major Richard P. Strong, professor of tropical diseases at the Harvard Medical School; Major Hans Zinsser, professor of bacteriology at Columbia University; Major W. B. Canon, professor of physiology at the Harvard Medical School.

Dr. Oscar H. Sellings, Columbus, Ohio, who was recently placed in charge of the work of the American Red Cross for the children of Marseilles, France, has been made head of the temporary commission sent by the American Red Cross to Italy.

L. W. Chase, professor of agricultural engineering at the University of Nebraska, has been appointed major in the Ordnance Corps, U. S. Army.

Assistant Professor Harvey B. Lemon, of the department of physics, University of Chicago, has been commissioned captain in the Ordnance Department of the Army and assigned to duty as head of the instrument division of the proof department of the Aberdeen Proving Ground, Aberdeen, Md.

Professor Max M. Ellis, of the department of biology of the University of Colorado, has

been given leave to accept a commission as first lieutenant in the Sanitary Corps. He is stationed at Mineola, L. I., for work with the Medical Research Board of the Air Service Division.

Dr. C. A. Brautlecht, professor of chemistry in the Florida State College for Women, has been called into the Sanitary Corps as first lieutenant. He is stationed at the Rockefeller Institute for Medical Research at New York.

Dr. James F. Kemp, formerly professor of geology in Columbia University, has left Tulsa, Oklahoma, to resume permanent residence in New York.

Dr. M. Lebredo, a leading hygienist and bacteriologist of Cuba and a member of the editorial staff of the *Revista de Medicina y Cirugia* of Havana, has been appointed a member of the Rockefeller Institute and is leaving on a scientific mission for Ecquador on behalf of the institute.

G. I. Christie, superintendent of agricultural extension of Purdue University, has been granted leave of absence to become assistant to the secretary of agriculture, in charge of farm-labor problems. T. A. Coleman, state leader of county agents, will serve as extension director during his absence.

Professor G. A. Miller, of the University of Illinois, has accepted the chairmanship of a committee which is to make a survey of the mathematical instruction given under the auspices of the Y. M. C. A. at the various naval stations.

Dr. Lucius P. Brown, who, following an investigation of the health department by the Hylan administration, was tried on charges of neglect of duty and acquitted, has been unanimously reinstated as director of the bureau of foods and drugs of the New York Health Department.

William Earl Hidden, known for his work in mineralogy, died at Ocean Grove, N. J., on June 12, 1918, at the age of sixty-five years.

The death is announced, on July 14, of Dr. R. O. Cunningham, emeritus professor of natural history and geology, Queen's College, Belfast, at the age of seventy-six years.

Dr. Alfred Senier, since 1891 professor of chemistry in Queen's College and University College, Galway, Ireland, died on June 29, aged sixty-five years. His parents, about two years after his birth, emigrated to Wisconsin, where he received his early education; in due course he attended the universities of Wisconsin and Michigan. Professor Senier's researches in organic chemistry were devoted mainly to the cyanuric acids, to the acridines and to phototropic and thermotropic phenomena.

Professor J. Bishop Tingle, of McMaster University, Toronto, died at Ottawa, on August 6, after an illness of some weeks. Dr. Tingle was born at Sheffield, England, in 1866, and received his early training at the Royal Grammar School of Sheffield and at Owens College, Manchester. He took his degree, after working with Claisen at Munich, in 1889. He came to America in 1896 and after some years at Lewis Institute, Chicago, Illinois College, Jacksonville and Johns Hopkins University was appointed to the chair of chemistry at McMaster University. He was elected fellow of the Royal Society of Canada in May, 1918. He was the author of a considerable number of scientific papers. Several of his students are already rising to positions of prominence as chemists. He was a pioneer, against much discouragement, in training young women for laboratory positions under war conditions. He married Sarah Ellen Capps, of Jacksonville, Illinois, in 1906. She survives him with a daughter and a son, also a younger brother and sister. Dr. Tingle was a valued friend to those who knew him intimately and he always took a close personal interest in the future of his students.

For the care and conditioning of fliers in the Air Service the United States Government is now appointing a corps of doctors and trainers large enough to equip each training field and camp for fliers, both here in the United States and in France, with a proper organization. The doctors will be known as flight surgeons and the trainers as physical directors. The medical branch of the Air Service is not alone confined to the selection of the flier but to his care and condition after

he has been admitted to the service. It has become apparent that the flier is unlike other soldiers. In the Air Service he has become an intricate, highy sensitized piece of mechanism with troubles all his own. To keep his complex organism physically fit a special master mechanic had to be provided solely for him. The flight surgeon, therefore, has been given freedom of independent initiative in all questions of fitness of the fliers. Subject to the approval of the commanding officer, he is expected to institute such measures as periods of rest, recreations, and temporary excuse from duty as may seem advisable. He takes sick calls of aviators, he visits such cases as may be in the hospital and consults with the attending surgeon regarding them. He makes the examination of candidates for aviation and lives in close touch with fliers. The physical directors are assistants to the flight surgeons and their duty is to supervise such recreation and physical training of the fliers as is considered necessary.

A THREE months' course at New York University and Bellevue Medical College will begin on September 4 for laboratory assistants, trained in bacteriological work. They are needed for immediate service for camp and hospital work. The course is in response to a request of the surgeon general's office of the War Department. There will be daily sessions from 9 to 5, except Saturdays. Efforts to secure scholarships covering the cost of tuition for expressly qualified women will be made. Futher information can be secured from Dr. William H. Park, at the Department of Health laboratory, foot of East Sixteenth Street.

NEARLY 50,000 physicians will be required for war service eventually, according to the Army and navy authorities, and in order to prevent the disorganizing of their teaching staffs of the medical schools, it is proposed to commission all teachers and assign them to their present duties. Of the 143,000 doctors in the United States it is estimated that between 80,000 and 95,000 are in active practise and that 23,000 are in the Army or Navy.

THE War Department has approved the request of the director of Chemical Warfare Service to furlough back to approved institutions a limited number of teachers of chemistry. This furlough will be administered by the committee on education and special training, old Land Office Building, Washington, D. C., upon recommendation of the officer in charge of university relations, Chemical Warfare Service. Approved institutions which have already lost many of their instructors through draft or enlistment may now make application for the return of such men, provided that the return is agreeable to the men themselves. In the event of failure to secure the men asked for, the relations section may be able to provide for the assignment of other men whose qualifications would seem to fit them to carry on the work of instruction. Application for furlough of enlisted men should be made to Chemical Warfare Service, University Relations Section, Seventh and B streets, Washington, D. C.

A BILL "to prohibit the importation of nursery stock into the United States in order to prevent the introduction of insect pests and plant diseases" (Senate Bill No. 3344) has been introduced by Senator Weeks of Massachusetts. The bill is of considerable interest to entomologists, plant pathologists, horticulturists, and all who have observed the repeated introduction of insects and plant diseases on imported nursery stock, particularly during the past fifteen years. The bill provides that it shall be unlawful for any person to import or offer for entry into the United States any nursery stock, with the exception of field, vegetable and flower seeds, bedding plants and other herbaceous plants, bulbs and roots. It is provided, however, that the Secretary of Agriculture may import, grow, and propagate nursery stock for experimental and scientific purposes, and after holding this stock in quarantine for a length of time sufficient to establish its freedom from insect pests and plant diseases, he may distribute it under such regulations as may be necessary.

The United States Coast and Geodetic Survey has issued a map of the north Atlantic Ocean, including the eastern part of North America and the greater part of Europe. The western limits of the map are Duluth to New Orleans; the eastern limits Bagdad to Cairo; extending from Greenland in the north to the West Indies in the south. The scale is 1:10,000,000. The map brings the two continents vis-a-vis in an approximately true relation and scale in an extremely clear manner, and will serve as an excellent base for various purposes. It is constructed on a system of projection which is peculiarly adapted to this wide expense, and is known as the Lambert Conformal Conic Projection with two standard parallels. The scale on the two standard parallels (36 middle parallel (41 degrees north) it is but 1⅛ per cent. too small, and beyond the standard degrees and 54 degrees north) is true; on the parallels the scale becomes increasingly large. The map covers a range of longitude of 170 degrees on the middle parallel—a range which on many other projections of this area would have distinctions and scale errors so great as to render their use inadmissible. This map can be obtained by writing to the department of the United States Coast and Geodetic Survey. The map is 24 by 46 inches, No. 3,070 and sells for 50 cents.

The *Journal* of the American Medical Association states that for seventeen years Dr. M. Uribe Troncoso edited the *Anales de Oftalmologia* in Mexico, but with his recent removal to New York, this journal was merged with others to form the *American Journal of Ophthalmology*. The Mexican Ophthalmologic Society, of which he was long president, has now decided to publish its own annals, and the *Anales de la Sociedad Oftalmologica Mexicana* has already made its appearance. Dr. D. M. Velez is director of the *Anales* and perpetual secretary of the society. Summaries of the two leading articles are given in both English and French, and duplicates are published on an insert for convenience of reviewers. The officers of the society for 1918 include Dr. F. Lopez, president; Dr. A. Chacon, vice-president, and Dr. E. F. Montaño, perpetual treasurer.

The Committees on Agriculture and on Administration and Commissions of the Massachusetts legislature have reported a bill to abolish the present Board of Agriculture and to substitute a board consisting of a commissioner of agriculture at $5,000 annually and fourteen unpaid advisory associates, one from each county. The present board consists of forty odd members. The secretary is executive officer. The bill makes no provision for the proposed consolidation of the Board of Agriculture with the Bureau of Animal Industry, State Forestry Department and Fish and Game Commission.

On April 9 an allotment of $25,000 was made by the President from the fund for the national security and defense for the purpose of enabling the Bureau of Fisheries to install a plant on the Pribilof Islands for the utilization of the by-products in connection with the taking of fur seals on these islands. This is regarded as vitally important at the present time in order to increase the production of oil and fertilizer. It is planned to make use of the carcasses which will result from the increased killings of fur seals this year. It is believed that the plant will more than pay for itself in the first season of its operation. Every effort is being made to obtain delivery of the plant in time to utilize the maximum quantity of seal carcasses during the current year. On April 27 the steamer *Roosevelt* left Seattle with a full cargo of general supplies for the Pribilof Islands. The cargo consisted of building materials, foodstuffs, and miscellaneous items. It was planned to return with utmost dispatch, bringing back such sealskins as were ready for shipment, in order that another trip may be made as soon as possible to transport material for the by-products plant.

The permanent secretary of the Paris Academy of Medicine has been authorized to accept, in the name of the academy, a legacy of 25,000 francs made by the late Dr. Magnan. The revenue from this sum will be used to establish a triennial prize to be awarded to the author of the best work on mental medicine.

After due consideration of a number of proposals for the alteration of the British system of weights and measures, such as the compulsory adoption of the metric system and the decimalization of the existing weights and measures, the British trade committee has decided against any compulsory changes at the present juncture, but recommends a continuation of the efforts toward simplification in the teaching of weights and measures and the use of decimal subdivision of basic weights, such as the cental of 100 pounds instead of the hundredweight (112 pounds) and the short ton of 2,000 pounds. The committee recognizes the value of the proposal for the decimalization of the sovereign, which would be divided into 1,000 mils, the mil being worth 4 per cent. less than the farthing. It believes, however, that considering "the magnitude of the disturbance which the alteration in the value of the penny would cause in the lives of the great body of wage earners, retail shopkeepers and their customers . . . the introduction of such a change would be inexpedient at a time when the social, industrial and financial organization of the country will be faced with numerous and exceptional difficulties."

The second reading of the British Coinage (Decimal System) Bill was moved by Lord Southwark in the House of Lords on June 4. Lord Leverhulme opposed the motion, though he was not against the principle of decimal coinage. He objected to making the sovereign the unit and dividing it into one thousand parts, and he thought that a British decimal system of coinage should be based upon the halfpenny. After discussion, the debate was adjourned on the understanding that the government will institute an inquiry into the whole question of decimal coinage, including the proposals contained in Lord Southwark's bill.

The Bureau of Mines announces the perfection of a type of electric melting furnace that may be revolutionary in the making of brass. Patents on this furnace, known as the rocking electric furnace, have been taken out by the bureau and have been assigned to Secretary Lane as trustee. Free licenses to operate these furnaces under the patents, it is understood, can be obtained by making application through Van. H. Manning, director of the Bureau of Mines. The new furnace, which it is claimed will reduce the important losses in brass melting, is the result of five years' experimentation by H. W. Gillett, chemist of the Bureau of Mines, in cooperation with the laboratory of Cornell University, the American Institute of Metals, and a number of manufacturers of brass.

## UNIVERSITY AND EDUCATIONAL NEWS

By the will of the late Lord Rhondda the governing body of Gonville and Caius College, Cambridge, will receive out of the residue of his estate the sum of £20,000, to be applied at its discretion for the benefit of the college, but preferably in the establishment and maintenance of six to ten scholarships tenable at the college for mathematics, natural science, or moral science (including economics), preference being given, *ceteris paribus,* in the awarding of such scholarships to residents or sons of residents in Wales or Monmouthshire.

A. H. Benton, assistant professor of farm management, at the University of Minnesota, has accepted a position as professor and chief of the division of farm management and rural economics at the Manitoba Agricultural College.

A. B. Coble, associate professor of mathematics in Johns Hopkins University, has accepted a professorship of mathematics in the University of Illinois to begin work in September.

Dr. Aven Nelson has been appointed president of the University of Wyoming.

## DISCUSSION AND CORRESPONDENCE

### PSEUDO-PSYCHOLOGY

To the Editor of Science: Through no fault of their own, not a few instructors of elementary psychology to my knowledge spend many an arduous hour trying to indicate to undiscriminating minds both what psychology

is not and what is not psychology. Press reporters, magazine writers, novelists, dramatists, preachers, popular lecturers, and advertising experts, are responsible for much psychological heresy that is so deeply rooted in the lay mind. But equally pernicious is the influence of teachers, yes, even academic colleagues in other disciplines, who, though their tutelage in psychology dates back to a previous generation, flaunt their opinions on the subject as if antiquity of the vintage were a guarantee of acceptability of the doctrine. Coupled with these agencies for the propagation of malefic and subversive statements is the human, almost inhuman, tendency to conjure with words and phrases that are suggestive of possibility but, among those so using them, not redolent with meaning or precise in definition. Thus have "psychology" and "psychological" suffered immensely. For what member of an English-speaking community can fail to be impressed, if not inspired, by the sound of the expression, "the psychological moment"! What greater distinction can be accorded an insignificant alienist in court than to whisper with bated breadth or to state in bold type that he is a famous "psychologist"! It has been said that officers in camp frequently explain the inexplicable in similar terms. Indeed, a current committee of the American Psychological Association has found it necessary to indicate restricted usages of the term "psychological" even among professional psychologists. But to my mind the most insidious of all baleful influences are to be found in connection with such commercialized undertakings as impose upon the ignorance of the general public to the extent of taking advantage of its credulity. Whether the intention of doing this is present or absent, is difficult of proof and, moreover, not to the point: the effect is the same.

The week's mail brought to my notice an attractively printed pamphlet describing the aims and scope of an incorporated "National Psychological Institute." Hence the occasion for these remarks. The individual whose name appears on the title page is the medical adviser and a trustee of the institute. His credentials indicate that he is a member of several medical societies, fellow of the American Medical Association, member of the American Association for the Advancement of Science, and of the National Geographic Society. No affiliation with any psychological association is mentioned. The institute "was organized in the firm realization that the Science of Life and an intelligent appreciation of the relationship between the visible and the invisible world, constitutes not only the highest form of religion but also falls within the domain of scientific endeavor" and for the purpose of carrying on "experimental research in normal and abnormal psychology and demonology . . . , to develop and instruct psychic-sensitives, as intermediaries in above stated experimental research, and grant certificates to same when proficient," etc. "Despairing mortals, on the brink of a suicide's grave, are especially urged to communicate (strictly confidentially) with the institute for advice regarding so serious a step." We are told that "research in abnormal psychology has unmistakably demonstrated that ignorant or mischievous discarnated human entities do frequently play a serious rôle in all manner of functional mental aberrations and insanity, the ravages of which, according to eminent authorities, are threatening the very social fabric." More specifically the symptomatology of shell shock "suggests obsession or possession by spirits of dead soldiers . . . as the exciting cause."

These quotations and other uncited but similar statements speak for themselves. It is not my purpose to decry earnest endeavor to gain knowledge in fields in which its pursuit has not so far been very fruitful. For many years, as my students can no doubt abundantly testify, my attitude toward psychic research has been respectfully sympathetic. In my reviews of publications on the subject, moreover, I have been no more critical than are the foremost investigators in this field. Nor do I intend to charge this institution with an attempt to defraud the public for financial gain. Representations in the pamphlet indicate that the organization is benevolent and humanitarian in character and not established for profit.

What that means is, perhaps, not altogether clear because "dependable automatists" are to be trained and awarded certificates, abnormal cases are to be treated, and negotiations with other institutions are encouraged, but surely not without fee. No, my chief criticism is simply: why do all this under the name of *psychology?* There is hardly an academic institution that would designate this subject as anything but "psychic research"; and certainly, if I judge aright, no scientific body of psychologists would endorse the selection of so ambitious a title for organizations at work in the field described in the pamphlet. The use of such a name involves bad taste and delusion, if it does not also bespeak audacity and professional discourtesy. Especially at this time of national service in an emergency ought scientific bodies to be particularly sensitive lest those in authority who are susceptible to misinformation proceed to belittle and to caricature the achievements already won. This is peculiarly true of so youthful a scientific discipline as psychology.

CHRISTIAN A. RUCKMICH
UNIVERSITY OF ILLINOIS

### THE POSITION AND PROSPECTS OF BOTANY

TO THE EDITOR OF SCIENCE: There are times when it is perhaps to be expected that the naturalist should feel, more insistently than other scientific men, the impulse to justify the pursuits with which he has chosen to occupy his time. The recent address by Dr. Gager, concerning the position and prospects of botany, printed not long ago in SCIENCE, prominently conveys an attempt of this kind. Like most of the pleas advanced by investigators in defence of their performances, this address develops the traditional theme of economic benefit accruing to society at large, and more specifically to certain groups of business interests, as the result of research activities.

It is strange that the peculiar futility of this type of apologetic seems not to be more generally appreciated. That the results of scientific inquiry contribute to the well-being of humanity is a tiresome truism, which has no bearing upon the support of research by business interests. Perhaps in despair at the lack of other common ground upon which to engage in discussion with nonscientific acquaintances, perhaps from the honest conviction that economic good is the main consideration in this matter, investigators have at any rate been far too willing to point to useful inventions, commercial practises and hygienic improvements, as the crowning fruits of the spirit of discovery. To this habit may in large degree be traced the origin and perpetuation of that conception, commonly enjoyed by cultivated people of nonscientific interests, that science is a vaguely delimited mélange of engineering, sanitation, surgery and what not else.

To encourage the demand, upon specific economic grounds, that research in biology should receive the financial support of commercial organizations is futile and dangerous: it is also a tactical error of the first magnitude. It is futile because the appeal fails, and in the nature of things must fail, to impress the people for whom it has been designed; because it omits to reckon with the fact that "usefulness," in the ordinary understanding of that attribute, is an accidental by-product of research. It is dangerous because, as Dr. Sumner has clearly expressed it in another connection,[1] "the investigator who derives his support from the public treasury often finds his intellectual honesty sorely strained. More or less fictitious benefits to the community are conjured up in justification of work which ought to stand upon its own merits. The mental processes involved are insidious and the deceiver often ends by being himself deceived." It is a tactical mistake because it fosters a false conception of the relations of science to other pursuits; the continual insistance upon the "practical" justification, especially when this is urged as a basis for the commercial support of research, can only delay the arrival of a social readjustment which, by reducing the grossly disproportionate material rewards of commerce, will help to insure for science the social and

[1] Sumner, F. B., 1917, *Bulletin of the Scripps Instn. Biol. Research*, No. 3, p. 3.

political position it rightfully should occupy. That public eulogists of scientific achievement have rarely undertaken to dwell upon anything beyond the "practical" result argues that there is in them either a want of vision, or a lack of courage to force the consideration of a viewpoint devoid of popular appeal; perhaps both.

W. L. Crozier

Dyer Island

### LEAF BURN OF THE POTATO AND ITS RELATION TO THE POTATO LEAF-HOPPER

Throughout the northern section of the United States, from Montana to New York and south at least to Iowa and Ohio, there has been a remarkable epidemic of leaf burn on potatoes. The margins of the leaves of early varieties turned brown, the dead areas gradually widening until the leaves dried up and the whole field took on a burned appearance. In severe cases the stalks also withered and died.

Every potato section of Wisconsin was affected and a careful study by the writer showed that in every case the injury was directly proportioned to the number of potato leafhoppers (*Empoasca mali* LeB.) present. The nymphs of this species feed on the undersides of the leaves and first produce a wrinkling of the whole surface, with a slight upward rolling of the margin, and then the marginal burning appears. Long after the leafhoppers have acquired wings and flown away it is possible to determine the cause of the damage by observing the cast skins adhering to the under surfaces and the egg scars in the mid rib or veins of the burned leaves.

In cage experiments, using large numbers of leafhoppers, typical leaf burn was produced in four days. The relation of this injury to what has been previously diagnosed as "tip burn" is an interesting subject for future determination. The characteristic marginal burn is frequently so definite that it is possible that there may be something injected that produces more definite and widespread results than the mere mechanical extraction of the sap. There does not, however, seem to be the same specific relation that exists between the beet-leafhopper and the curly-leaf disease of beets.

E. D. Ball

State Entomologist,
Madison, Wis.

### "FATS AND FATTY DEGENERATION": A RESPONSE TO BOOK REVIEWS BY BANCROFT AND CLOWES

Wilder D. Bancroft[1] has recently reviewed in the pages of the *Journal of Industrial and Engineering Chemistry* a book entitled "Fats and Fatty Degeneration,"[2] by Marian O. Hooker and myself. He has also published in his *Journal of Physical Chemistry* a review by G. H. A. Clowes,[3] which in spirit is identical with his own. My attempt to answer both of these reviews in the pages of Bancroft's *Journal* has met with the editor's refusal.

Bancroft and Clowes's adverse criticisms are of two kinds: (1) those contradicting my observations and their interpretation, and (2) those implying unacknowledged borrowings from the works of others, more specifically their own writings. As to the first, it is the privilege of any critic to correct errors and to disprove arguments when truth and logic are on his side; as to the second, no reputable investigator would, even if moved by nothing better than the low ideal of his material future, jeopardize truth by taking it ready-made from another without noting that fact, or would pose as the discoverer of laws already set forth by authorities working in the same field. Those who know either me or the history of emulsion chemistry will easily find their way here. Yet, deferring to another article my answer to the scientific objections of Bancroft and Clowes—an answer that should be apparent to any careful reader of my book—I purpose in this note to comment upon their purely personal criticism.

Bancroft says:

> It is also interesting to note that the author does not cite Pickering's first paper, though he must be familiar with it. . . . It is certainly being overcharitable to say that the author has the unhappy

[1] Wilder D. Bancroft, *Jour. Ind. and Eng. Chem.*, 9, 1156, 1917.

[2] Martin H. Fischer and Marian O. Hooker, "Fats and Fatty Degeneration," New York, 1917.

[3] G. H. A. Clowes, *Amer. Jour. Phys. Chem.*, 23, 73, 1918.

gift of remembering what he has read but of forgetting that he has read it.

This idea is expressed by Clowes as follows:

> This statement is somewhat surprising in the face of Pickering's emulsification of 99 per cent. of oil in 1 per cent. of an aqueous soap solution, and Fischer's own data and illustrations (pages 40 and 78) of emulsions (borrowed without acknowledgment from Pickering even to the stick standing up in the jelly) in which 20 parts of oil are emulsified in one part of the water phase.

The scientific aspects of these statements are covered in my book and will be more fully discussed at another time, but the implication of unacknowledged borrowing I can not allow to pass. It happens that I have never had access to this particular paper of Pickering, published, I think, in the *Transactions of the Royal Society*. I believe, however, that I am conversant with Pickering's views on emulsions from such of his papers as have been accessible to me in the original. With regard to the stick inserted in the jelly to test its stiffness, what more boyish means could any investigator employ for such a purpose? Surely he would not need to borrow from a printed illustration so simple an empirical device.

Clowes continues:

> In borrowing from earlier investigators the idea of tackling the problem of protoplasmic balance by studying the reversal of phase relations in emulsions, Dr. Fischer failed to make himself acquainted with the data already available regarding the conditions under which emulsions of water in oil may be formed, and emulsions of this type transformed into those of oil in water and vice versa.

Although I do not understand the expression "protoplasmic balance," Clowes evidently believes that I have slighted his work. On the contrary, Clowes's work on the theory of emulsification and his experiments on the transformation of oil-in-water to water-in-oil emulsions are fully acknowledged on pages 28, 29 and 30 of my book. I go so far as to try to harmonize our views, although I must now confess my inability to understand much of his work owing to the fact that he writes diffusely and jumbles good experimental observations with hypotheses. Here as elsewhere, however, I have followed a principle which has guided all my writings, namely, that of discovering and emphasizing only the positive contributions of any author, and of ignoring what seem to me his mistakes or false guesses.

Clowes writes further:

> In the chapter on fatty degeneration, Fischer fails entirely to give credit to Alonzo E. Taylor.

This statement is characteristically inaccurate, for Taylor's work is discussed on page 69 of my book. One is tempted to say of Clowes what Bancroft says of me, "It is a little difficult to characterize the author's methods and yet keep within parliamentary limits." Clowes might at least have done me the small justice of looking up Taylor's name in the index. Yet, as a matter of fact, Taylor was interested only in that chemical aspect of the problem of fatty degeneration which asks whether fat may be formed from protein. My own contributions to the subject have nothing to do with this; they deal instead with the physics of the question.

So far as the theory of emulsification is concerned, it is the intent in my volume to show that a union between solvent and lyophilic colloid (the formation of "colloid solvates" or "colloid hydrates") is *one* of the large and important factors in the maintenance of emulsions. This contention of mine is accepted as correct in Bancroft and Clowes's reviews. As a matter of fact the idea is looked upon by them as entirely self-evident, for Bancroft writes:

> When oil is emulsified in water by means of a third substance, one has drops of oil each coated by a gelatinous film. . . . If we cut down the water sufficiently we shall get a limiting case where we have merely drops of oil surrounded by gelatinous films.

Clowes expresses the notion in the words:

> Bancroft's demonstration that the formation of one or the other type of emulsion depends not upon the relative volumes of oil and water, but simply upon whether the emulsifying agent employed is preponderantly hydrophilic or lipophilic. . . .

This complete acceptance of my views is both gratifying and surprising, since neither Bancroft nor Clowes ever said or demonstrated anything of the kind until after the appearance of my various papers[4] and of the book which they review. Never before the time of these reviews has either used the terms "hydrophilic" or "lipophilic" in any of his papers on emulsification. Indeed, when I presented the importance of colloid solvates (Bancroft's "gelatinous films") for the understanding of the stabilization of oil-in-water and water-in-oil types of emulsions, at the 1916 Urbana meeting of the American Chemical Society, both gentlemen attacked my views[5] as impossible. At that time they were following Pickering's belief that the stability of an emulsion depends upon the production of an "interfacial film" between the two liquids which, in Bancroft and Clowes's mind, when bent one way, yielded an oil-in-water type of emulsion, and, when bent the other, a water-in-oil type.

Bancroft says further:

> **In so far as an emulsion of oil in water is stabilized by a hydrophilic colloid, there is nothing new about this.**

Here Bancroft disparages as not new the very idea which he had previously declared impossible. Of course the fact that emulsifying agents emulsify has been known since mother first made mayonnaise. What mother did not know was why her methods worked. So far as I am aware neither she, nor Clowes, nor Bancroft knew that the hydrophilic properties of colloids were an important element in the matter until I pointed this out.

Clowes concludes as follows:

> **While the writer of this review would not charge Dr. Fischer with any deliberate intention to mislead, the obvious haste with which this somewhat pretentious work has been constructed suggests an attempt to skim the cream of a new idea in a promising field of research.**

[4] Martin H. Fischer and Marian O. Hooker, Science, 43, 468, March, 1916; Kolloid Zeitschr., 18, 100, 1916; 18, 242, 1916.

[5] See "Fats and Fatty Degeneration," p. 29, for an account of this.

The statement in the first clause withdraws the whole charge of the critic and is inconsistent with his earlier paragraphs. His succeeding inference is unjustified and absurd. In any case scientific research presents too bounteous a table for those who sit at it to haggle over the cream.

I conclude these quotations with an opinion by Bancroft which reveals his personal animus and embraces not only my volume on fats, but all my books:

> **The author's books are all interesting reading, and this one is no exception; but they should be considered as advertising matter in the guise of scientific fiction.**

Thus, from his original contention at the meeting of the American Chemical Society that my views are untrue, Bancroft has come to contend that they are not new; and then, insecure upon this ground, he turns from discussing scientific issues and discusses me.

With this brief presentation I rest my case. Decision is, fortunately, not confided to *ex parte* attorneys; it is the portion of disinterested third parties, of science and of time.

Martin H. Fischer
Eichberg Laboratory of Physiology,
University of Cincinnati

## QUOTATIONS

### A MEDICAL ENTENTE WITH AMERICA

We published last week an account of the very cordial reception accorded to British medicine in the persons of Sir James Mackenzie, Sir Arbuthnot Lane and Colonel Bruce by the American medical profession during the recent annual conference at Chicago. That event marks an important stage in the development of understanding and sympathy between the two countries, not only because the doctor wields in every community a large if undefined influence, but also because it is well that in the great war against disease which is now in its opening stages the two peoples should stand side by side, mutually supporting one another. American medicine has much to give, and we know that the same can be said of our own profession. The time is opportune for the

cultivation of a closer relationship than has hitherto existed, for the creation of new facilities of study, for the endowment of research fellowships on both sides of the Atlantic, and for the interchange of scientific papers and schemes of work.

Alive to the advantages to herself of a scientific *entente,* Germany before the war used all these means to attract American students to her universities and schools, and to send her students to American schools. A very large measure of success attended her efforts, with the result that not medicine alone, but the sister sciences of chemistry, bacteriology, sanitation and sanitary engineering reaped immeasurable benefits. In this country we have at last awakened to the vast importance of health and of all questions affecting it. Public opinion has demanded that a Health Ministry shall be called into being, and will see to it that the activities of that Ministry, when it comes, are not curtailed in its struggle with disease and ignorance and greed. Public opinion will equally insist that the knowledge gained and progress made by our American friends, who have essayed this task in a broader spirit and at an earlier date than ourselves, are fully utilized, and the support that they may be willing to afford us secured. We shall fight our battle with hands greatly strengthened if we fight it as members of a world-wide community. Disease is international. The hope of the conquest of disease lies in prevention, which must be international as well as local. In this respect no man and no community can say that they live to themselves. A badly constructed drain in a country village contaminating a source of water supply may give rise to an epidemic of great proportions, and this may conceivably be carried by hosts of one kind or another to the world's end. We hope, therefore, that a scientific *entente* will not stop at medicine in the narrow sense of that term. America, for example, leads the whole world in the matter of its milk supply, and our bacteriologists and social workers cannot afford to let the opportunity of help in this direction remain unimproved. Our Ministry of Health, indeed, when formed, will be strengthened in every way by the establishment of friendly relations with the State Boards of Health that have already done so much for America. We are aware that some steps towards the development of such a policy as we suggest have lately been taken, and that other measures are in contemplation. This is satisfactory so far as it goes. But the broadest possible basis of understanding is the best basis in the circumstances, and all branches of scientific work having the public health as their object should take part in the movement.—London *Times.*

## SCIENTIFIC BOOKS

*Principles of Economic Geology.* By William Harvey Emmons. McGraw-Hill Book Co. 1918. Pp. 598.

There are two recent books with which this at once invites comparison—Lindgren's "Mineral Deposits," and Ries's "Economic Geology." It is not as comprehensive as the latter, for it omits the whole of the important subjects of coal, oil and other fuels. Perhaps for this reason and to avoid confusion in title the word "Principles" is added. To the reviewer the fact that every improvement in transportation or manipulation, like the cyanide process, increases the value of the raw material and consequently lowers the grade of the material which it will pay to work, that there is a tendency to work from small quantities of high-grade material to large quantities of low-grade material, that production is normally in an accelerated ratio, should be classed as principles of economic geology. But it would not be easy for the student to pick out these or any other *economic* principles. The economic data are indeed scanty and not systematic, and there is little or no attention paid to the principles of valuation.

But if the economic side is scantily handled the geologic receives much fuller treatment. In fact twenty-one out of twenty eight chapters are concerned with the classification of ore deposits in general, their structural features and sources. Particularly valuable is the summary prefixed to the earlier chapters on the different types of deposits. Chapters

17 on structural features is also valuable. Mine waters also receive better treatment than they often do. But in his argument for the importance of ascending juvenile thermal waters one might have hoped to see a comparison of the analyses of waters with those which would be obtained from the connate or meteoric waters stimulated in circulation by hot intrusives. There is a lot of sodium carbonate and sulphate in the mine waters of many regions where "alkali" is also characteristic of the surface waters, while the mine waters of other districts are quite different. It may well be that we have a mixture of waters from more than one source, and while the author rightly attributes to precipitation by mixture of solutions an importance which is often overlooked, yet it may have even greater importance.

The range of reference is rather narrow, mainly, though by no means exclusively, to the western United States. In that respect both of the other books are superior. For instance in discussion of the class of zeolitic native copper deposits no reference is made to the work of Weed and Lewis on those of New Jersey, and one might think that Keweenaw Point was unique, except for a footnote reference to White River, Alaska. With regard to the Keweenawan deposits there are a number of minor slips (p. 397). Copper veins are still of considerable importance at the Ahmeek and adjacent mines, nor was the copper obtained from veins formerly, nor at present, wholly or mainly sulphide. It is usually native, sometimes the basic arsenide, and even in the Nonesuch lode one would hardly say that the ore was "chiefly" chalcocite. The Nonesuch mine saved only the native copper. It is noteworthy that there is no such systematic attempt to present diverging points of view fairly as is made by Ries. Compare for instance the treatment of oolitic iron ores in each. This is probably due to the origin of the book as a course of lectures. So, too, while Lawson is referred to, as to his western work, no reference is made to his Lake Superior work. Neither is Allen's declaration that the Animakie is middle Huronian considered. The Keweenawan is classed without a question as pre-Cambrian.

After the extensive treatment of ore deposits, iron, copper, gold, silver, zinc and lead receive treatment in separate chapters, while all the rest of the substances are dismissed in the last hundred pages.

Two relatively new terms are protore: "low-grade metalliferous material not itself valuable from which valuable ore may be formed by superficial alteration and enrichment," and the horsetail structure applied by Sales to divergent minor fractures. Both these seem to be useful.

There is no list of illustrations.

Alfred C. Lane

*Aquatic Microscopy.* By Alfred C. Stokes. Fourth Edition. New York, John Wiley and Sons. 1918. Pp. 324.

The new edition of this well-known guide for beginners retains the general features of the earlier editions. Chapter XII. of the third edition, "Some Common Objects worth Examining," has been replaced by a "Synopsis of the Preceding Chapters," which is a convenient, brief key to the forms described in the book. Minor changes have been made in the text, various scientific names have been modernized, and some of the keys have been extended. The book should continue to be a favorite, not only with the young microscopist for whom it is intended, but with many zoological students and teachers as well who desire to identify quickly and easily some of the commoner aquatic organisms.

M. F. Guyer
University of Wisconsin

## SPECIAL ARTICLES

### ADAPTATION IN THE PHOTOSENSITIVITY OF CIONA INTESTINALIS

I

*Ciona intestinalis* of the Pacific Coast[1] re-

[1] These experiments, the details of which will appear later, were performed at the Scripps Institution for Biological Research at La Jolla, California. My thanks are due to Dr. Ritter and his staff for the many courtesies shown me.

acts vigorously when exposed to light. The pigmented ocelli on the oral and atrial siphons are not the sense organs concerned. Stimulation of the ocelli does not result in a reaction, and their removal in no way interferes with the sensitivity of *Ciona*. The receptors responsible for the light sensitivity are localized in the inter-siphonal region in an area corresponding to the neural complex of ascidians. When this spot alone is exposed to light, the resulting effect is identical with the one following total body exposure.

II

The reaction time of *Ciona* to light is composed of two portions. The first is a sensitization period, during which *Ciona* must remain exposed to the light. The second is a latent period during which *Ciona* need not be exposed to the light. At the end of this period it gives its characteristic reaction, though at the moment it is no longer subjected to the source of stimulation. This latent period as found by averaging many determinations on a number of animals at different intensities, is 1.76 seconds.

III

The sensitization period (or roughly speaking, the reaction time) varies inversely as the intensity of the stimulating light. Moreover, the duration of the sensitization period multiplied by the intensity of the light is constant. This means that the amount of energy (time $\times$ intensity) required by *Ciona* for a reaction to light is the same for all intensities. This is a familiar phenomenon in the chemical effect of light (Roscoe-Bunsen rule) and signifies that the light decomposes a constant quantity of photosensitive substance before *Ciona* reacts to light.

IV

When kept in diffuse daylight, this species does not respond to a lower intensity of light. It does react to sunlight. However, if *Ciona* is placed in the dark, it will become "dark adapted" after a time and will respond to an artificial light of as low as 500 candle meters intensity. The investigation of the *rate* at which it becomes "dark adapted" is of considerable interest. This is found by determining the reaction time of an animal to a light of constant intensity at 15-minute intervals in the dark-room. The following is found to be true. At first the reaction time is long, then it shortens rapidly, then slowly, and finally it becomes constant.

The duration of the exposure time multiplied by the intensity of the light gives the amount of energy received. The amount of energy determines the quantity of photosensitive substance decomposed. Therefore, the extent to which the photosensitive material requires to be is changed in order to produce the same reaction during "dark adaptation," is at first large, then it decreases rapidly, then slowly, and finally it becomes constant.

The significance of this rate of change will become apparent when we shall have considered the nature of the photosensitive substance and its mode of formation.

V

Decomposition of the photosensitive material by light, presupposes the formation of this substance within the sense organ. It will simplify matters to assume that the action of the light results in the conversion of the photosensitive material into its precursor. Thus normally, and of course in the dark, the precursor ($P$) forms the substance ($S$) sensitive to light. In the light, however, $S$ is converted back into $P$.

The rate of formation of the precursor from the photosensitive substance in the presence of light, has been shown to be a direct function of the amount of energy supplied by the stimulating light. The occurrence of the reaction in the opposite direction, however, must be considered in terms of the velocities of ordinary chemical reactions. The formation of the photosensitive material from its precursor is probably a reaction of the first order. For our purposes, however, it may be a reaction of even a higher order. Practically all chemical reactions have this in common: the velocity of the reaction is at first rapid, then

it slows down gradually, and finally it reaches a point of equilibrium which represents a definite ratio between the concentrations of the reacting substances.

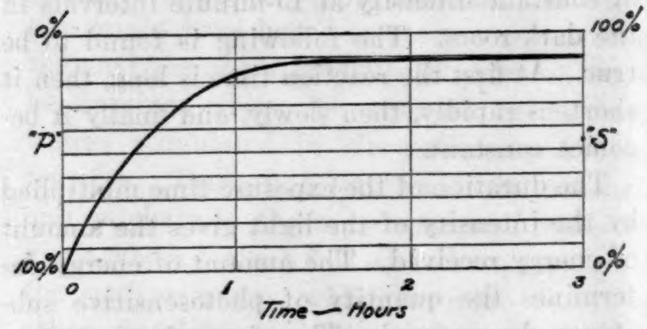


FIG. 1. Hypothetical course of the reaction $P \rightarrow S$ (formation of photosensitive substance) which takes place during dark adaptation of *Ciona*. The regular change in the reaction time during dark adaptation depends on this chemical reaction. The curves expressing this change may be duplicated by plotting a constant fraction ($\frac{1}{10}$) of the unused $P$ against time as abscissa.

In the case under consideration, the relation between the two substances may be represented in Fig. 1. The ordinates at the right indicate the per cent. of photosensitive substance ($S$) formed from the precursor ($P$). The ordinates at the left give the amount of the precursor ($P$) remaining during the progress of the reaction.

The production of the photosensitive substance in the sense organ of *Ciona* undoubtedly takes place in this manner when the animal is placed in the dark room. It will be seen from Fig. 1 that the amount of the precursor ($P$) is at first large, then it decreases rapidly, then slowly, and finally it reaches a constant minimum. This is also what happens to the reaction time, and therefore to the amount of photosensitive substance broken down before a reaction can occur during the process of "dark adaptation."

Since it was assumed that the photosensitive material decomposes into its precursor, the amount of the precursor formed at each reaction during dark adaptation, runs, in general, parallel to the amount of the precursor still unused in the reaction. Therefore, in order to serve as an "inner stimulus," the quantity of precursor formed by the stimulating light must bear a definite quantitative relation to the amount already present. This is merely the basis of the familiar Weber-Fechner concept, that the amount of stimulus necessary to produce a perceptible increase in sensory effect represents a constant fraction of the quantity of stimulus that has gone before.

## VI

The crucial test of any explanation lies in its ability to predict the course of events. Such a test was applied to the hypothesis suggested above.

We do not know with any accuracy the course of the reaction taken to form the photosensitive substance from its precursor. But the reverse reaction—the formation of precursor from sensitive material—has already been shown to follow the Roscoe-Bunsen rule. Consequently, the quantity of precursor present depends upon the amount of light energy which the animal has recently received.

If a dark adapted *Ciona* is repeatedly exposed to light at sufficiently close intervals of time, only a negligible quantity of new photosensitive material should be formed. The amount of precursor produced by the light, however, will depend entirely upon the total exposure time. Moreover, if it is true that, in order to act as a stimulus, the amount of precursor formed must bear a constant ratio to the amount already present, the reaction time should always bear the same relation to the reaction times that have preceded it.

This is indeed found to be the case. *Cionas* that have been kept in the dark for several hours, and are then exposed to light at intervals of a minute, and their reaction times taken, follow exactly the prediction outlined above. A curve drawn with time as ordinates, and sensitization periods (reaction time minus 1.76 seconds) as abscissas, has a simple logarithmic form corresponding to the usual Weber-Fechner expectation. If instead, the logarithms of the sensitization periods are used as abscissas, the resulting curve is a straight line. This indicates that the amount of energy required to produce a reaction at any stage in the repeated stimulation is a con-

stant fraction of the amount of energy which the sense organ has received previously.

VIII

Repeated stimulation of the kind just described, has frequently been called a process of adaptation to a stimulus. As such it has been used as a criterion for the presence of a "higher behavior" in many animals. Similarly, the fact that the reaction time continues to increase steadily has been taken to indicate a process of learning.

The experiments forming the basis of this communication, have, however, shown that these phenomena are dependent on changes which take place within the sense organs themselves. In addition, they have demonstrated that the process of "adaptation" to a photic stimulus in *Ciona* is subject to the course of a chemical reaction. The reverse of this reaction determines the ability of the organism to become "dark adapted." Furthermore, the changes which occur in the reaction time during both of these adaptional processes are consistent with the principle underlying the Weber-Fechner rule. This requires that in order to act as a stimulus, the light must form a quantity of a substance such that it will bear a definite ratio to the amount of that substance already present in the sense organ. The matter of "higher behavior" is nowhere evident in these experiments.

SELIG HECHT

PHYSIOLOGICAL LABORATORY,
CREIGHTON COLLEGE OF MEDICINE,
OMAHA, NEBR.

## A METHOD FOR PREPARING PECTIN

PECTIN bodies is a term applied to a group of substances occurring in practically all plants and fruits. They are complex carbohydrates, probably derived from one mother substance known as pectose, and are closely allied to the plant gums and mucilages. Pectin occurs most abundantly in the apple, quince, currant and gooseberry and appears in small quantities in strawberries, raspberries, etc. In suitable amounts of sugar and acid the pectins have the property of gelatinizing fruit juices or hot-water extracts of fruit pulp in which they are present or to which they may be added. The reason why some kinds of fruit juices do not jelly is due to an insufficient amount of pectin being present in them. For example the practise of mixing apple juice with raspberry or strawberry juice is for the purpose of increasing the pectin content and thereby make jelly from juices where it would be impossible to do so otherwise. The juices from the various kinds of fruits are known for their distinctive flavors. These qualities are impaired when a combination of juices are blended together. For this reason it has been the aim of manufacturers to make high-grade jellies from the low-containing pectin fruit juices by adding to them the purified pectin. The pectin, as now prepared, is very expensive and therefore its use in jelly-making is very limited.

Pectin is slightly soluble in water and therefore the pulp or pomace resulting from the pressing of ripe fruit contains practically all of the pectin. Hot water will slowly extract the pectin and for this reason fruits are cooked to a pulp with water before extracting the juice for jelly-making.

In the fruit-producing sections of the state of Washington, there is a considerable amount of cheap material such as cull apples, pomace from cider presses and cores and peelings from canning establishments which go to waste. This waste material might be utilized for the preparation of pectin which, in turn, could be used in making jelly from those fruit juices which lack pectin. The object of the experiment carried on in this laboratory was the finding of some simple and inexpensive process for the preparation of pectin from these waste products, without the use of alcohol, as is the case in Goldthwaite's[1] method.

The principle of the method is based upon the fact that pectin as extracted from the pulp or pomace is in a colloidal state and can be readily changed by electrolytes. Since pectin, after precipitation, must be dispersed again in order to be of any value as a gelatinizing agent, an electrolyte that will produce a reversible precipitation must be chosen. Also

[1] *J. Ind. and Eng. Chem.*, 2 (1910), 457.

the electrolyte chosen must be non-poisonous. Lead acetate or basic lead acetate will precipitate pectin, but the precipitation is an irreversible one, and the amount of lead absorbed or combined may be poisonous. For these reasons ammonium sulfate was chosen. Bigelow, Gore and Howard[2] in their review of the literature on pectin mention that in 1898 Bourquellot & Herissey used ammonium sulfate as a precipitant for pectin obtained from gentian root. Other than this no further use has been made of this precipitant for pectin.

### METHOD

60 grams of dried apple pomace were boiled three successive times with 200 c.c. of water, filtering after each boiling. To each of the 100 c.c. of filtrate 25 grams of ammonium sulfate were added[3] and then heated to 70° C., whereupon the pectin was precipitated as a grayish white flocculent precipitate. The precipitate was separated from the mother liquor by filtering. (The mother liquor can be evaporated and the residue used again or the residue can be used as a fertilizer.) The precipitate was dissolved in hot water and again precipitated with ammonium sulfate. Again it was filtered and the precipitate was removed from filter paper and dried at 60–70° C. and when dry was washed several times with cold water to remove adhering ammonium sulfate. The precipitate was dried again and its gelatinizing power was tested by adding to a 1 per cent. solution of the pectin 0.5 per cent. solution of citric acid and 65 gm. of sugar. This solution was boiled for 10–20 minutes and upon cooling a nice stiff jelly was produced. The taste did not indicate the presence of ammonium sulfate and upon dissolving the jelly in hot water only a slight milkiness was produced when tested for sulfates.

In order to determine whether the yield of pectin by the above method was equal to the yield produced by the alcohol precipitation method, two samples of apple pomace from the same lot were treated exactly alike, except that ammonium sulfate was used in one case and alcohol in the other as the precipitating medium. The pectin was dissolved and reprecipitated in each case, then filtered and the precipitate was removed from filter paper and dried. The ammonium sulfate was removed from the one by washing with cold water, again dried and weighed. The amount of pectin recovered by each method is recorded in table below.

| Precipitant | Pectin, Per Cent. |
|---|---|
| Ammonium sulfate | 6.33 |
| Alcohol | 6.91 |

The amount of ammonium sulfate used can be reduced by concentrating the extract, either by evaporating on a steam bath, in a partial vacuum or by freezing.[4] The quality of the pectin is not impaired in either case.

### SUMMARY

Pectin can be prepared by adding ammonium sulfate to the hot water extract of fruit, and heating to 70° C. The amount of pectin recovered is practically equivalent to that recovered by the alcohol precipitation method.

Concentrating the pectin extract below the boiling point did not impair the quality of the pectin.

Chas. H. Hunt
Washington Agric. Experiment Station,
Pullman, Wash.

[2] Bul. 94 U. S. Dept. Agr. Bur. Chem.

[3] If wet pomace is used it will require a somewhat larger amount of ammonium sulfate. First add 25 grams per 100 c.c. and if precipitation does not occur, add successive portions of 5 grams until precipitation occurs. The pectin may also be precipitated by saturating the solution in the cold with ammonium sulfate.

[4] J. S. Caldwell, Bul. 147, Wash. Agr. Exp. Sta.

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